Internet of Things Technology Implementation for Hydroponic Planting Culture

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Internet of Things Technology Implementation for Hydroponic Planting Culture

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Abstract. This study aims to develop the application of information technology in the field of agriculture, especially the method of farming in a hydroponic way. Hydroponic cultivation method is cultivation that can be done with the utilization of vacant land/yard of the house. With a hydroponic cultivation system, a small home garden yard can be used as farming land. The research method used in this research is the Microsoft Solution Framework (MSF) with waterfall system development method and Object Oriented Development (OOD) method for its approach method. Stages in this study include problem identification, preliminary planning, design and design, piloting and implementation. The result of this research is a prototype product of an IoT system applied in a hydroponic cultivation system. Contributions to Knowledge may extend the repertoire of research in the field of development, particularly in the event of information technology involved in agriculture, especially in cultivation using hydroponics; The results can be used as references in the development of the next IoT system.

1. Introduction

Yogyakarta is one of the big cities in Indonesia. The narrowness of agricultural land in urban areas, especially in the city of Yogyakarta, forces a method of farming which can be done by utilizing vacant land/yard at home. Based on information from the Jogja Tribune news portal that was accessed on June 15, 2017 [1], and from BPS Jogjakarta statistical data [2], it was known that agricultural land in the city of Yogyakarta was shrinking. Until 2016, agrarian land left only 56 hectares (ha) or around two percent of the total area of the city area of 3,250 hectares. Based on these problems the solution that feels right is to develop hydroponic agriculture or better known as the verticulture system. The application of technology in various fields of human life is needed, especially the application of information technology in agriculture, especially in food security. The use of information technology in the area of food security is made one of them with the Internet of Things (IoT) technology. Internet of things is an emerging field which has improved the quality of human life with its large automated applications. The functionalities provided by IoT can save time and computational power of users to help improve results in the diverse application areas. IoT is a structure in which objects, people are provided with exclusive identity and the ability to relocate data over a network without requiring two-way handshaking between human-to-human or human-to-computer interaction [3]. IoT technology adopts for smart farming to enhance efficiency, productivity, global market and other features such as minimum human intervention, time and cost, etc.[4] The application of IoT to the farming system with hydroponic systems uses sensors that are adapted to the needs of plant monitoring. This study will implement IoT on a network of farming with hydroponic systems. Based on the description of the above problems, it is necessary to research the application of IoT technology in agriculture, especially

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in the use of hydroponic systems in the Yogyakarta area. It is expected that with the technology applied to the hydroponic farming system, the method of farming becomes easy and the results can also be utilized maximally in the household.

2. Method

The research method used in this study is the Microsoft Solution Framework (MSF) [5][6], with the process of developing the waterfall system and the Object Oriented Development (OOD) method for the approach method. The stages in this study include problem identification, initial planning, design and design, trial and implementation. The output to be achieved is a product in the form of an IoT system prototype that is applied in a hydroponic farming system.

2.1. Literature review

The research by [7] describes that Internet of Things can be predicted that facility agricultural will have a rapid development in the promotion of agricultural machinery, sensors, information and communications, and cloud computing technologies. It will play a significant role to improve the overall efficiency of agriculture, promote the upgrade of modern agricultural transformation. [8] Presented an idea of utilizing the internet of things (IOT) for agriculture, food quality and safety. A mobile application (app) for the sensing layer of the IOT technology was developed, and the app shows that the freshness of food could be investigated by studying the picture of the food and comparing it to the reference picture. The condition of the food whether it is fresh, excellent or spoiled could be shared with all consumers and food supervisors through the network and application layers of the IOT technology

In the study conducted by [9], artificial intelligence technology in agricultural IoT has been successfully used in agrarian sensors, and they have advantages of small size, simple structure, simple operation, high precision, high sensitivity, and fast response, but they still have shortcomings of a limited range of applications, high cost, needing maintenance and others. Even though big data, cloud computing, and artificial intelligence technology have been successfully used in greenhouse, water, soil, agricultural production, irrigation, information identification and data detection and other agricultural IoT areas, and have achieved a number of related functions, due to the high cost, lack of standard technology and other factors, the full range of applications of big data, cloud computing and, artificial intelligence. The research by [10] purpose to explore the possibility of applying IOT for agriculture to trace and track food quality and safety. Mobile application for food freshness investigation was successfully developed, and the results showed that consumer mobile camera could be used to test the freshness of food. By applying the IoT technology, this information could be shared with all the consumers and also the supervisors

3. Results and Discussions

3.1. IoT Architecture for Hydroponic Planting Culture.

Internet of Things Technology Implementation for Hydroponic Planting Culture consists of hardware and software. The device comprises of sensors, controls, power supplies (solar panels), wifi modules. The software includes microcontroller programming software and user interface via the web. The sensor comprises a light sensor, temperature sensor, and humidity sensor, and the control system comprises of atmega 328 microcontroller and an ESP8266 module for wireless communication. The power supply consists of solar panels, batteries and control panels. The power supply for this system uses solar panels. Figure.1 shows the overall architecture diagram of the Internet of Things Technology Implementation for Hydroponic Planting Culture.

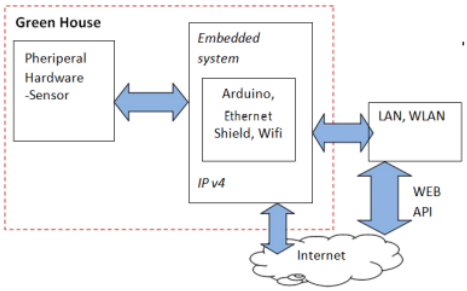

Figure 1. Architecture diagram of the Internet of Things Technology Implementation for Hydroponic Planting Culture

3.2. Circuit and Working.

In the schematic design described the arrangement of components and pathways used to create a prototype IoT for Hydroponic Planting Culture. The plan is done using Proteus software. Schematic model of IoT for Hydroponic Planting Culture prototype is shown in Figure 2.

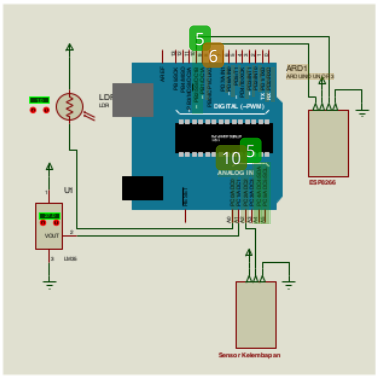

Figure 2. Schematic design of IoT for Hydroponic Planting Culture

In number 1 the sensor module consists of a light sensor, a temperature sensor, and a humidity sensor. The ESP module functions for wireless communication.

3.3. Work principle

The working principle of the IoT for the Hydroponic Planting Culture prototype shown in Figure 3. In Figure 3 it is explained that the IoT for the prototype Hydroponic Planting Culture is placed of 2 parts, hardware, and software. The device consists of the power supply (solar panel, panel controller, battery), a sensor as an input to the microcontroller which is placed in the hydroponic system, and ATMEGA 328 control as the main control center. ATMEGA 328 microcontroller is equipped with an ESP8266 module for communication with users using the internet. Users can obtain information on temperature, lighting, and humidity on hydroponic systems online.

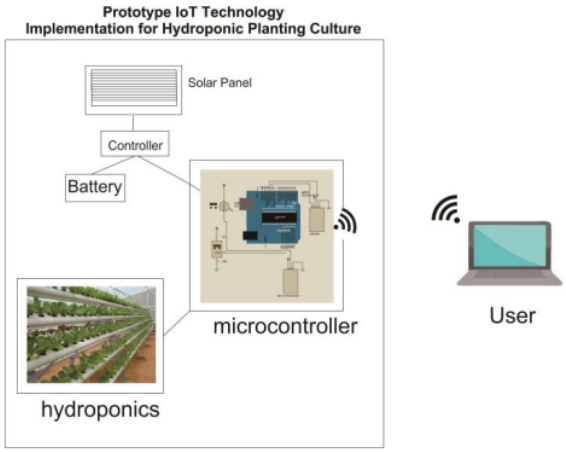

Figure 3. working principle of the IoT for the Hydroponic Planting Culture prototype

3.4. Experimental result

IoT for the Hydroponic Planting Culture prototype consists of hardware and software. Hardware testing results are obtained:

3.4.1. Testing solar panels

The results of solar panel testing can be seen in the following table 1.

Table 1. The result of solar panels test

Testing	Measurement results of voltage (Volt)	Results of measurement of current (Ampere)
Bright conditions	20 V	0,86 A
Cloudy conditions	10 V	0,05 A
Dark conditions	0 V	0

From the test, the solar panel is as expected. The solar panel testing process can be seen in Figure 4 below.

Figure 4. The result of solar panel testing

3.4.2. Testing of sensors and microcontrollers.

Sensor testing is done to determine the performance of the sensor. The sensors tested are temperature sensors, light sensors, and humidity sensors. From the measurement of the sensor, the results are obtained as desired. IoT for the Hydroponic Planting Culture prototype as shown in Figure 5.

Figure 5. IoT for Hydroponic Planting Culture prototype

3.4.3. The Test Results of the web interface.
The web interface is designed as a user interface using a PC / laptop. The web interface is designed to monitor the performance of sensors that provide information to users. Figure 6 shows the interface on the main activity web applications that have been created. In the picture is shown some conditions that are when opening the app.

Figure 6. Web interface IoT for Hydroponic Planting Culture prototype

4. Conclusion

Design of IoT for Hydroponic Planting Culture prototype has been successfully done. The IoT for Hydroponic Planting Culture prototype works well to monitor temperature, light, humidity via a web browser.

References

[1]. _____ . (2015). Luas Lahan Pertanian dan Bukan Pertanian menurut Kabupaten/Kota di D.I. Yogyakarta (hektar), 2015. *https://yogyakarta.bps.go.id/linkTabelStatis/view/id/54*

[2]. _____(2015). Ternyata Lahan Pertanian di Jogja Tinggal 65 Hektare. *http://www.tribunnews.com/regional/2015/06/18/ternyata-lahan-pertanian-di-jogja-tinggal-65-hektare*

[3]. Tahir, H., Kanwer, A., Junaid, M. 2016. Internet of Things (IoT): An Overview of Applications and Security Issues Regarding Implementation. International Journal of Multidisciplinary Sciences And Engineering, Vol. 7, No. 1, January 2016.

[4]. Vinayak N., Malavade., K, Pooja., Akulwar. 2016. National Conference On "Changing Technology and Rural Development. IOSR Journal of Computer Engineering (IOSR-JCE), pp 56-57.

[5]. Roger S. Pressman. 2003. Software Engineering – A Practitioner´s Approach. McGraw Hill, 5th Edition, December 2003.

[6]. G. Lory, "Microsoft Solutions Framework," Version 3.0, http://www.microsoft.com/technet/itsolutions/techguide/msf/msfovr *(PDF) Comparação de Metamodelos de Processos de Desenvolvimento de Software*. Available from: https://www.researchgate.net/publication/233992976_Comparacao_de_Metamodelos_de_Processos_de_Desenvolvimento_de_Software [accessed Nov 07 2018].

[7]. Zhou, L., Song, L., Xie, C., Zhang, J. 2012. Applications of the Internet of Things in the Facility Agriculture. 6th Computer and Computing Technologies in Agriculture (CCTA). Springer, IFIP Advances in Information and Communication Technology, AICT-392 (Part I), pp.297-303.

[8]. Srinivasan S.P., Shanthi, D. S., Aashish., Anand. 2017. Inventory transparency for agricultural produce through IoT. International Conference on Aerospace, Mechanical, and Mechatronic Engineering. IOP Publishing IOP Conf. Series: Materials Science and Engineering 211 (2017).

[9]. Han, S., Zhang, J. Zhu, M., Wu, J. 2017. Analysis of the frontier technology of agricultural IoT and its prediction research. ISAMSE 2017 IOP Publishing IOP Conf. Series: Materials Science and Engineering 231 (2017).

[10]. Witjaksono, G., Rabih, A. A. S., Yahya, N. B., Alva, S. 2018. IOT for Agriculture: Food Quality and Safety. ICEAMM 2017 IOP Publishing IOP Conf. Series: Materials Science and Engineering 343 (2018).

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